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Integrated Management of Timber-Elk-Cattle: Interior Forests of Western North America

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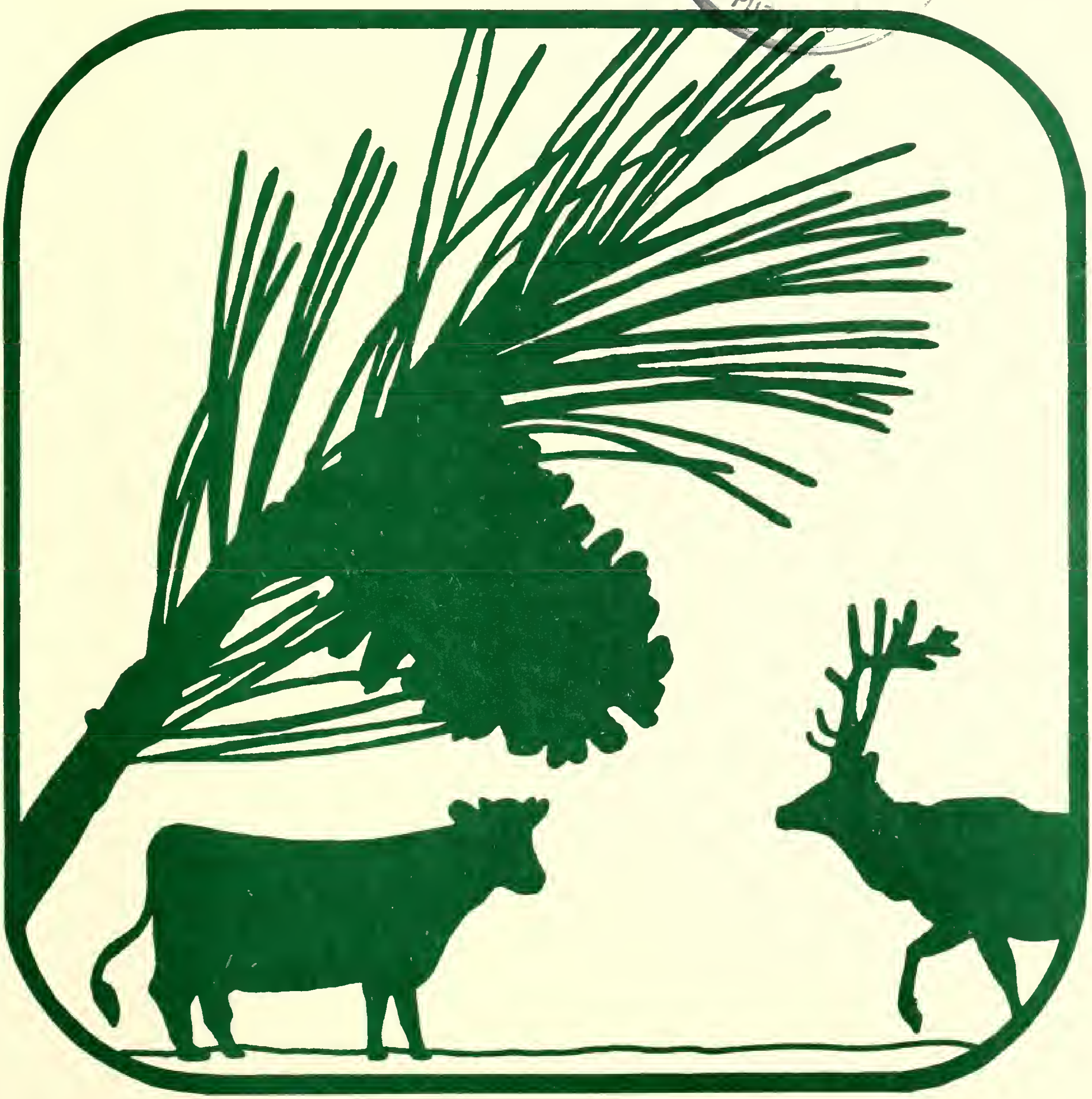

Foreword

Resource managers in the United States and Canada must face increasing demands for both timber and wildlife. Demands for these resources are not necessarily incompatible with each other. Management objectives can be brought together for both resources to provide a balanced supply of timber and wildlife. Until recently, managers have been hampered by lack of technique for integrating management of these two resources. The goal of the Habitat Futures Series is to contribute toward a body of technical methods for integrated forestry in British Columbia in Canada and Oregon and Washington in the United States. The series also applies to parts of Alberta in Canada and Alaska, California, Idaho, and Montana in the United States.

Some publications in the Habitat Futures Series provide tools and methods that have been developed sufficiently for trial-use in integrated management. Other publications describe techniques not yet well developed. All series publications, however, provide sufficient detail for discussion and refinement. Because, like most integrated management techniques, these models and methods have usually yet to be well tested, before application they should be evaluated, calibrated (based on local conditions), and validated. The degree of testing needed before application depends on local conditions and the innovation being used. You are encouraged to review, discuss, debate, and—above all—use the information presented in this publication and other publications in the Habitat Futures Series.

The Habitat Futures Series has its foundations in the Habitat Futures workshop that was conducted to further the practical use and development of new management techniques for integrating timber and wildlife management and to develop a United States and British Columbia management and research communication network. The workshop—jointly sponsored by the USDA Forest Service and the British Columbia Ministry of Forests and Lands, Canada—was held on October 20-24, 1986, at the Cowichan Lake Research Station on Vancouver Island in British Columbia, Canada.

One key to successful forest management is providing the right information for decisionmaking. Management must know what questions need to be asked, and researchers must pursue their work with the focus required to generate the best solutions for management. Research, development, and application of integrated forestry will be more effective and productive if forums, such as the Habitat Futures Workshop, are used to bring researchers and managers together for discussing the experiences, successes, and failures of new management tools to integrate timber and wildlife.

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Abstract

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The need for and the evaluation of elk-habitat evaluation models are reviewed, and a state-of-the-art example is presented that incorporates distribution of elk-habitat use related to distance from cover/forage edges, distance from roads, cover quality, and forage quantity and quality.

Keywords: Integrated management, timber management, wildlife habitat management, grazing management, models.

Contents

Problem Analysis

The Issue

The Rocky Mountain elk (*Cervus elaphus nelsoni*) often receives consideration in forest management in the intermountain West, where the species primarily lives in mountainous terrain characterized by conifer forests at relatively high elevations and grass and shrublands at lower elevations. The issue we analyze in this paper is how this elk habitat is evaluated in forest planning and management.

Concerns

The Rocky Mountain elk (hereafter elk) is highly valued for both hunting and esthetic reasons. The elk is primarily associated with publicly owned lands; for example, about 94 percent of the Rocky Mountain elk in the United States in the late 1970's resided for all or most of the year on National Forests (Thomas and Sirmon 1985a, 1985b). Many societal demands are made on public lands in North America for numerous resources including fish and wildlife, livestock grazing, minerals, recreation, timber, and water. Simultaneous exploitation of these lands for two or more resources requires both the understanding of interactions between management to achieve goals for each purpose and the manipulation of these interactions to meet management objectives. These interactions are not confined to biological relations but are also influenced (probably most strongly) by an admixture of economic, social, and political factors. Management of the elk is complicated further by a mixture of public and private land within the ranges of most elk herds. Objectives sometimes vary widely between owners of the lands, between owners and government agencies responsible for the elk, or both.

The compatibilities and conflicts between land-management practices that result in various forest and rangeland products have become better recognized as more unmanaged land has been brought under management. Land-use planning has revealed and dealt with the need for allocating resources between factions that demand different amounts under various circumstances.

Consideration and resolution of multiple-use management problems are complicated by the need, whether formalized or implied, to consider cost/benefit ratios and by questions of equity among user groups, regions, and classes of landowners. Resources from managed land that are perceived as amenities, such as elk, do not have market values and often do not receive the same emphasis as commodities that produce revenue for agencies, individuals, or communities.

Land management has become complex—biologically, economically, socially, politically, and administratively—over a brief period. Wildlife biologists must operate effectively and efficiently in the arenas where the fate of elk and elk hunting is being determined through two evolving processes: (1) habitat evaluation by means that can be incorporated with evaluations of other resources in land-use planning and (2) credible expressions of economic values associated with exploitation of elk. This discussion is confined to consideration of habitat evaluation.

Historical Approaches to Issue Resolution

Three historical phases have affected elk: unregulated natural resource exploitation from 1850 to 1920, recovery of elk habitat and numbers from 1920 to 1960, and the management from 1960 to present. The period from 1850 to 1900 was characterized by unregulated hunting of elk and by severe overgrazing of elk ranges by domestic livestock. Elk were extirpated from much of their range and dramatically reduced in numbers to less than 90,000 by 1922.

Then, elk numbers began to increase because of protection from unregulated hunting, drastic reductions in livestock numbers on USDA Forest Service lands, and reintroductions of the species to former range. By 1935, elk had recovered to the point where hunting was permitted, and 3,378 elk were legally taken by hunters. The number of elk legally killed by hunters increased to 19,020 in 1945, 67,454 in 1955, 77,334 in 1965, and 103,830 in 1975 (Potter 1982). Rocky Mountain elk populations were estimated at 422,665 in 1976 (Bryant and Maser 1982). Obviously, the control of elk killed by hunters, reintroductions, and enhanced range conditions through control and distribution of livestock numbers were dramatically successful.

By 1960, the management emphasis of National Forests that contained primary elk habitat began to change from forest protection and regulation of grazing to timber harvest and management. Associated with this change in management was a dramatic increase in road construction in previously unroaded or lightly roaded areas.

When considering elk, land managers began to focus more on the effects of timber management (Lyon 1979), livestock grazing, and human access from increasing miles of roads. Elk numbers and hunting quality became and continue to be the issues and are addressed here.

The pre-1979 literature on the effects of timber management, roads, and livestock grazing on elk habitat is summarized by Lyon and Ward (1982); Nelson (1982) also reviews livestock grazing impacts on elk. Literature on other elk-habitat influences was reviewed by Lyon and others (1985).

Before the development of the first widely applied elk-habitat models in 1975 (Black and others 1976, Thomas and others 1976, Thomas and others 1979) biologists addressed habitat considerations for elk in managed forests with recommendations—lists of "do's and don'ts" (Lyon 1975 and 1980, Pedersen and others 1980, Ruediger 1977, Ward 1980). The most comprehensive, best documented, and well-supported recommendations were reported by investigators with the Montana Cooperative Elk-Logging Study 1970-1985 (Lyon and others 1985); several recommendations are given here as examples:

1. "Security during logging operations...Preparation of timber sales in elk summer range should include planning to attain minimum losses in habitat security during the period of road construction and logging.

2. "Redistribution of elk...Timber sales should be planned in a manner that minimizes potential problems arising from temporary redistribution of elk onto adjacent or other nearby property.

3. "Traditional home range use by elk...Before timber sales are established and new roads are constructed, information should be obtained concerning traditional use patterns and distribution of elk harvest so that cutting can be timed and roads placed to have the least undesirable effect on both elk and elk hunting.

4. "Road construction and design...As part of the location and design of transportation systems, existing habitat occupancy and movement patterns and probable elk crossing areas should be identified and provisions made to maintain security for unimpeded movement...A number of considerations can help to minimize the loss of habitat security:

- Locate permanent and high-volume traffic roads in those areas least used by elk.

- Design secondary roads, in both construction and layout, to facilitate eventual closure. This is particularly important where roads enter drainage heads.

- Maintain frequent dense cover areas adjacent to the road.

- Avoid road construction in saddles or low divides frequented by elk in crossing ridges between drainages.

- Construct roads to the lowest standard that will meet management objectives. In important elk range this usually implies a low-speed, single-track construction without large cut slopes, fills, or straight stretches.

- Dispose of road right-of-way slash so it does not inhibit elk movement.

- Locate roads, even temporary roads, to avoid disturbance of moist sites and other areas of concentrated use by elk.

- Avoid areas of important elk winter range.

5. "Road management...Where maintenance of elk habitat quality and security is an important consideration, open road densities should be held to a low level, and every open road should be carefully evaluated to determine the possible consequences for elk...High priorities for closure

- roads in the heads of drainages, saddles, and low divides,

- roads through moist areas and wet meadows,

- loop roads that encourage through traffic,

- trunk roads with many dead-end side roads under one-half mile in length,

- midslope roads in the lower two-thirds of the drainages (especially in fall),

- roads in known calving areas (especially in spring),

- roads in winter range concentration areas (especially in winter), and

- roads in areas with poor cover (especially in fall).

6. "Clearcuts...In order to assure that forage produced in clearcuts is in fact available for use by elk, openings should satisfy the following criteria:

- Slash cleanup inside clearcuts should reduce average slash depths below 1.5 feet. Slash in excess of 1.5 feet will reduce elk use by more than 50 percent.

- Openings should be small, even though openings up to 100 acres may be acceptable where the adjacent forest edge supplies adequate security.

- In western Montana, some security cover is provided within openings by vegetation growth, and elk use increases in older cuttings. In central Montana, the younger openings are preferred by elk; security should be provided by designing clearcuts so that the best available cover occurs at the uncut edge. Thinning adjacent to clearcuts is not recommended.

- Additional security, which will significantly increase elk use of clearcut openings, can be provided with appropriate road closures.

Assessment of how effective such "guidelines" or "recommendations" have been in influencing timber, road, and livestock management to benefit elk is difficult to make. Our impression is that they have had a positive influence on elk habitat over what would have occurred in their absence. The degree of attention paid to such guidelines, however, varied from location to location depending on circumstances—the most obvious being the acceptance and effectiveness of the wildlife biologists and the receptiveness of managers. Such management guidelines derived from and supported by research are, nonetheless, essential tools for evaluating or guiding elk habitat management.

By 1976, modeling was becoming the order of the day in land-use planning and in analysis of effects from alternative forest management actions. The variables that many biologists believed strongly influenced elk use of habitat were combined into models that could be jointly considered with models describing timber, livestock, and other resource responses to the same or different management actions.

The first elk-habitat model (Mark I) that received widespread use was derived for use in the Blue Mountains of Oregon and Washington (Black and others 1976, Thomas and others 1979). This model was based on the size, spacing, and juxtaposition of cover (hiding and thermal cover) and openings in the forest (created or natural) called forage areas (see Peek and others 1982 for a discussion of cover). These relations were generalized into cover/forage ratios as one criterion of habitat effectiveness and scored from a 0 to 1.0 scale. The score was then multiplied (discounted) by a record score (again, on a 0 to 1.0 scale) derived from the number of miles of road per square mile of habitat (Lyon 1983) to produce a habitat-effectiveness index.

From experience in field use and testing of its criteria and assumptions, the Mark I model evolved to the Mark IV model (Leckenby 1984). This evolution has been described by Thomas and others (1988). The Mark IV model will be described later in this paper as a case example of an elk-habitat management tool.

Other models designed to help evaluate elk habitat in managed forests began to appear after 1976. Models were designed for specific situations by biologists from the Interagency Study Team (1977) for northern Idaho, from the Montana Department of Fish and Game and the USDA Forest Service (1977) for central Montana, and from the northern region of the USDA Forest Service and the Montana Department of Fish and Game (1977) for eastern Montana, as well as by Leege (1984) for northern Idaho, by Wisdom and others (1986) for western Oregon and Washington, and by Thomas and others (1979) for eastern Oregon and Washington. Lyon and others (1984) reported specific sets of evaluation criteria for the Bitterroot, Kootenai, Bridger-Teton, and other National Forests.

Lyon and others (1985:48) described these modeling efforts as follows:

> The major strength of this localized interagency approach to management planning is that results from many different studies of elk can be integrated with local knowledge of habitats and elk behavior ...local guidelines represent a further level of precision and a potential for managers to recognize the importance of elk behavior in relation to local environmental conditions. Almost without exception, prescriptions for maintaining productive elk habitat now include both the physical components (thermal cover, hiding cover, foraging areas) and some components related to elk behavior within the physical environment (cover interspersion, road density, livestock management, and traditional use). Many prescriptions also recognize the influence of habitat change on recreational hunting, with the result that land managers and game managers are working together to integrate hunting seasons and harvest goals. Strong cooperative relationships between informed and involved agencies and landowners are essential where maintenance of elk populations is a management objective.

From research on elk reaction to each variable, general agreement seems to exist on which variables should be included in elk-habitat models. Much less knowledge and agreement, however, exists on how the variables interact to exert an overall influence on elk-habitat effectiveness.

The models and techniques of habitat evaluation described above have had an effect on how the managed forest landscape is evolving—about that there is little doubt. The impact has been considerable where these evaluation criteria have been used over a 10-year period. Thomas and others (1988) said of the Blue Mountains:

> Up to now, the developing managed forest landscape has been sculpted by silvicultural practices, primarily regeneration cuts, applied timber sale by timber sale. The cumulative effect is a managed landscape molded, to a large extent, by elk habitat considerations....

More difficult to know is if the models accurately reflect habitat effectiveness for elk. Such evaluations are extremely complicated and most elk-habitat models predict only effectiveness of the habitat to facilitate elk use. They are neither designed nor expected to predict elk numbers or productivity. Consequently, evaluation of elk and timber coordination guides are rare. Exceptions do exist (Leckenby 1984 and Lyon 1984), and more such evaluations are sorely needed. Resource management agencies are receiving considerable pressure to demonstrate that any constraints on timber or livestock grazing activities benefit elk and are thereby justified. Alleviating skepticism will require more monitoring and evaluation of current elk-habitat models.

Management Context and Alternatives

Considering the present state of competition in allocation of forest resources during land-use planning, particularly on public lands, we believe it is likely that: (1) an increasing emphasis will be placed on the use of models in making management decisions; (2) biologists considering elk habitat in managed forests will have to produce, evaluate, and upgrade habitat-evaluation models that express values that can be integrated into forest planning; (3) these models must be useful at levels from overall forest planning to evaluation of management units and the layout of timber sales; (4) the number of biologists and resources to conduct analyses will continue to erode and there will be greater reliance on remote sensing and machine handling of analyses; and (5) habitat-evaluation models must reflect the primary facets of elk-habitat concerns in the fewest variables that can serve as a reasonable facsimile of habitat interactions and that can be formulated for quick and efficient measurement and analysis.

We believe the only alternative to such modeling is to hold on to old ways of presenting concerns and of trying to impose ad hoc constraints on those interested in producing and harvesting wood and forage. Experience to date indicates that such a course of action would be relatively ineffective, expensive, and difficult compared with the use of models. Key to effectiveness is determining overall trends and, then, exercising leadership to guide these trends to their most beneficial conclusions. Few alternatives seem to exist to modeling if wildlife biologists want to be effective in accounting for and influencing changes in elk habitat in managed forests.

To be effective, wildlife biologists must learn to participate effectively in a new game or, perhaps, an old game but with new rules and techniques. This will require additional skills in remote sensing, coordination with other specialists, and communication in various user groups. The levels of sophistication and application of modeling, remote sensing, and biopolitics will likely increase in the near future.

Forest managers of public land, particularly in the United States, are legally and politically required to account for elk welfare during allocation of resources in forest management. As conflicts over resource allocations intensify, the reaction by critics to models that produce constraints on or reductions in commodity production will be insistence on model verification. Managers must have confidence in the model that is commensurate with the intensity of the conflict over resource allocation—that is, the more money and jobs at stake, the more intense the political activity, and the higher the chances of appeal or court action, then the higher the degree of confidence required. Conflicts will likely intensify with each cycle of planning and allocation because demands increase when the "resource pie" remains the same size or

shrinks. In short, the pressure will constantly be on wildlife biologists to improve and evaluate the models and to monitor the application in the process of allocating lands for elk habitat in managed forests.

Case Example of a Habitat Evaluation Model

The Mark IV model that has been developed for evaluating elk winter ranges in the Blue Mountains of Oregon and Washington (Thomas and others 1988) serves as an example of a timber-cattle-elk management tool in the Habitat Futures Series. This model contains the habitat components identified by Lyon and others (1985, p. 48) as common to existing models and prescriptions of elk-habitat conditions, including both the physical components (thermal cover, hiding cover, foraging areas) and some components related to elk behavior within the physical environment (cover interspersion, road density, livestock management, and traditional use).

The original Mark I model (Thomas and others 1986) was developed by a team representing all governmental agencies that would be using the model. This bio-political approach assured the highest probability of implementation of the model. The model was field tested by Forest Service and Oregon Department of Fish and Wildlife biologists and revamped to overcome problems uncovered by users.

An intensive extension program was then undertaken by the developers of the model. From 1976 to 1986, about 85 presentations and workshops were conducted to describe the model and to train potential users. As time went by, these training sessions were expanded to include use of remote-sensing and computer-aided analysis techniques.

Biologists in other geographical areas developed models they felt were more appropriate to their geographical area, resource base, information base, and social situation. It seems inevitable, and probably desirable, that each group of biologists will create a different version of how the basic habitat components listed above by Lyon and others (1985) are considered in evaluating habitat in various geographical areas. This allows adjustments for local conditions and gives biologists and agencies ownership in their product, which enhances confidence in the model and the chances that the model will be applied in management. A downside exists, however, to having a variety of extant models. Critics may label variety as nonstandardization and suggest this as evidence of inaccuracy (or lack of precision). Demands may then be made for more proof that models accurately reflect the need for described habitat components. We believe, however, elk select habitat on the basis of what is available, and forest lands are very different from one geographical area to another. Models of elk habitat can be expected, therefore, to also vary from one geographical area to another.

If the elk-habitat evaluation models are to gain widespread use, the models must be couched in terms understandable to other natural resource specialists, particularly those trained in forestry and range management. The best of models is worthless if it is not used—and to be used, a model must be understood.

By 1979, the confidence of users increased to the point that the Regional Forester for the Pacific Northwest Region of the Forest Service and the Director of the Oregon Department of Fish and Wildlife formally agreed that the Mark I model would be the basis of all evaluation of elk habitat in the managed forests of eastern Oregon. Since its distribution, the tool has been constantly evaluated by users through field application. In addition, extensive research conducted between 1976 and 1986 by the Oregon Department of Fish and Wildlife and the Forest Service (Leckenby 1984) tested the hypotheses on which the Mark I model was founded (Black and others 1976, Thomas and others 1979). Those hypotheses were supported by the new information that provided more precise and site-specific data to support refined considerations of the variables in the model. Habitat conditions resulting from application of the model have not been monitored, and no monitoring is planned because of the lack of resources to conduct such activities. This is a glaring fault.

Use of elk-habitat evaluation models to estimate impacts on elk habitat from alternatives presented in National Forest plans has intensified political reactions as land-use planning has proceeded; for example, on the Wallowa-Whitman National Forest, several alternatives in the 1986 draft Forest Plan predict reduced timber harvest levels because of consideration given to elk habitat. Several groups have protested vigorously to any reduction in timber harvest because of management for elk habitat. A Congressman expressed disbelief and called for proof that levels higher than current levels of timber harvest would reduce elk populations. He was concerned that jobs would be sacrificed before proof existed that elk populations would be reduced from present or increased levels of timber harvest.

Questions Arising From Use of the Models

The habitat effectiveness models were based on research of how elk selected among and distributed use between habitat attributes. Consistent patterns of selection of various habitat attributes were assumed to indicate a biological advantage to elk. The assumption that purposeful and consistent behavior patterns by elk yield some benefit to the animal is probably valid. An extension of this assumption—that the habitat variable in question is necessary for the welfare and existence of the species—is much less certain. This extension is the target of critics who are primarily concerned with the economic and social impacts of meeting the elk-habitat objectives that have been determined with habitat-evaluation models.

At least five areas of research should be pursued to resolve problems with or strengthen confidence in use of the example model:

1. Develop capabilities to consider elk-habitat needs on a seasonal basis.

2. Describe relations between volume of traffic and elk willingness to use adjacent habitats.

3. Develop procedures to predict competition between elk and other ungulates on a site-specific basis.

4. Develop abilities to quantify the contribution of elk-habitat attributes to elk welfare.

5. Develop means of evaluating interactions between elk-habitat attributes in describing overall habitat quality.

6. Develop means of converting elk-habitat indices into potential numbers of elk that can be supported by or produced from such habitats.

Discussion

Beyond understanding the social and political conditions of natural resource management on public lands, wildlife professionals must learn to act effectively under such conditions—whether or not they agree with them. Changing these conditions is an aspect addressed on the political and legal levels and not at the technical level. Whereas before, wildlife biologists addressed a situation with a list of "do's and don'ts," modeling is now essential for effective management. The time for questioning whether to model or not to model is over. Wildlife managers must use models or withdraw from the game of wildlife management.

The next question is how to model. The temptation is to model with biological purity as the guiding principle. Well and good, but effectiveness requires further considerations—primarily recognition that modeling is a communication tool between researchers, wildlife managers, planners, other natural resource managers, and, ultimately, the discerning public. The goal is overall forest management. Wildlife, and certainly the welfare of single species, is merely a part of subset of the overall consideration.

The tool (the model) is simply a means to enhance communication, a mechanism through which to conduct evaluations. By itself, the model is nothing. It comes to life through application and through "selling" by the developers to the users. The selling and the need for improving the product never stops.

Users and proponents of elk-habitat models must be able to separate technology and its application from personal desires and biases. Forest management for multiple use implies less than maximization of any product, and compromise between uses and user groups is essential. The manager must make those decisions as constrained by law and plan. The specialist's job is to develop and apply technical means of predicting outcomes from various alternatives and to deal with ongoing management on a site-specific basis.

The best technology will not, of itself, produce resolution of natural resources management problems. After all, problems are the product of human recognition and interpretation and are with us always. The guiding principles, however, for developing and applying tools to enhance elk welfare in forest management include the following:

1. Do the best you can with what you've got. It is pointless to decry the state of knowledge. Remember forest management will proceed with or without inclusion of information on elk habitat presented in an effective manner. Construct models with available information and, therefrom, derive rational assumptions. Involve management specialists for other resources in development and extension of models to users.

2. Validate the models, whether the entire model or components of the model.

3. Direct research to provide additional information for model improvement.

4. Monitor results obtained through use of the model on the ground.

5. Update the model as required based on validation results, new research, monitoring, and experience in use.

We believe it is imperative that biologists develop models to ensure appropriate consideration of elk-habitat in forest management. The models that have been developed are in general agreement about which habitat attributes should be considered (thermal and hiding cover, foraging areas, cover interspersion, road density, and livestock management). Much less agreement exists, however, on how these attributes should be formulated into elk-habitat evaluation models. Interactions between habitat variables in the same model have not been explored, and effects of such interactions are apt to be profound. Models that are in use have rarely been evaluated. Such evaluations are sorely needed but extremely difficult to conduct with adequate precision.

Managers are pressing for development of models of elk habitat that will predict elk numbers and productivity. Such exercises may be futile because elk numbers are influenced dramatically by factors not accounted for in site-specific habitat models, such as weather anomalies, disease, hunting, management objectives, and so forth.

Elk-habitat models will receive increasing scrutiny as land-use planning intensifies. These models may well guide management strategies that constrain timber or livestock management opportunities. As these constraints are readily and inevitably converted to opportunity costs (that is, money and jobs) in the political arena, expect that the value of the elk-habitat models will be vigorously scrutinized and that pressure to improve these models will be constant.

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The need for and the evaluation of elk-habitat evaluation models are reviewed, and a state-of-the-art example is presented that incorporates distribution of elk-habitat use related to distance from cover/forage edges, distance from roads, cover quality, and forage quantity and quality.

Keywords: Integrated management, timber management, wildlife habitat management, grazing management, models.

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